Advanced Molecular Biology

2019 - 2020

Faculty:

1. Michele De Bortoli - Dept. Clinical & Biological Sciences, University of Turin
2. Santina Cutrupi - Dept. Clinical & Biological Sciences, University of Turin

Assistant/lecturers:

- Giulio Ferrero – post-doc fellow
- Jamal Elhasnaoui – PhD student

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Part 1 – M De Bortoli

Part 2 – S Cutrupi

Seminars: Elhasnaoui «alternative splicing» TBD
other seminars are difficult to set due to coronavirus emergency

Michele De Bortoli
Full Professor of Molecular Biology
Dept. of Clinical & Biological Sciences

PhD Programme in Complex Systems for Quantitative Biomedicine
(former Complex Systems for Life Sciences)

CMB Master - AMB

Advanced Molecular Biology

The main focus of this course is

regulatory genomics

CMB Master - AMB

- The functional organization of Genomes
- Regulatory mechanisms and motifs
- Regulatory networks
- Genome regulation and Human diseases

Course Structure

ca. 38 hours lectures (MDB)

ca. 22 hours lectures (SC)

Accessories (to be discussed)

(2 x 4 hrs hands-on databases & browsers)

ca. 10 hours reports (MDB)

Course objectives

Students will acquire an advanced level of knowledge on the activity of genes and genomes and the mechanisms of genome regulation at the transcriptional and post-transcriptional level, in the contexts of development, differentiation, cellular homeostasis and cancer.

In the **first part** of the course Students will understand how the modern global methods (microarrays, Next Generation Sequencing, epigenomics, protein-DNA, protein-RNA, proteomics), make it possible to represent the organization and control of most evolved genomes.

In the **second part** of the course, Students will acquire the ability to use their theoretical knowledge in solving applicative problems, with special regard to biomedical issues, through the study of literature. In particular, Students will learn how to associate the genomic variants and dysfunction with possible regulatory events and with disease states.

Specific objectives are:

- To make the point on how Molecular Biology has evolved since the end of the Human Genome Project and the advent of high throughput genome sequencing technologies
- To discuss advancements in regulatory Biology thanks to Genomics, with specific regard on the regulation of gene expression and gene interaction at the network level
- To introduce Students to understand Molecular Biology at the systems level
- To guide Students to the reading and interpretation of research articles in the field of regulatory molecular biology
- To make Students understanding the applications of genomics in the fields of medicine and neurobiology.

Expected outcomes

Knowledge

- the most common analytical methods in Genomics and transcriptomics, comprising the fundamentals of bioinformatics analysis of results
- the most important modalities of transcriptional regulation in higher Eukaryotes.
- the mechanisms of alternative RNA transcript generation, including non-coding RNAs and associated functions.
- the constitutive principles of gene regulatory networks
- the involvement and dysfunction of components of these networks in human disease

Expected outcomes

Ability

- to do literature searches on the course topics
- to search for information and expose a summary of the main methods of genomics and functional genomics
- to analyze, interpret and report publicly on a recent scientific article, including the methodology used, concerning one of the course topics
- to interpret results and diagrams relating to the main issues discussed
- to expose briefly one of the topics of the course, with specific reference to genomics and methodology

Expected outcomes

Understanding

- how a systems molecular biology study is planned and conducted; how results are presented and discussed in a primary scientific journal; and finally how results must be evaluated in the framework of current knowledge.
- which methodological approach (among those studied) should be used to answer a specific scientific question.
- what information can be obtained from genomic analysis to understand the molecular mechanisms associated with diseases;
- how to use this knowledge to develop a potential therapeutic strategy

EXAM

Students are expected to show:

1. Knowledge of **basic** concepts
2. Understanding of **specific** concepts
3. Comprehension of experimental **methodology**

Evaluation steps:

Within the course:

1) Students' activity on the Moodle website is monitored
2) Selecting, analysing and reporting to the class a scientific paper on specific themes is evaluated

33/30

After the course:

1) Moodle test with scoring and open questions — 33/30
2) Oral discussion on course subjects — 33/30

average

Due to the structure of proficiency evaluation,

Students are strongly encuraged to follow the activities step-by-step, doing all complementary activities on Moodle, and

→ taking the EXAM at the first sessions (summer).

In the international contexts, repetitive and delayed exam sessions - as we use in Italy -

is **absolute anomaly**

First part

There will be 5 Chapters (4+1)

For each Chapter, one Review and one Scientific Paper is assigned **in advance**

Students should read the material before the lectures, since this will enormously help understanding

Lecture workflow:

- Discussion of the assigned paper
- refreshing basic knowledge (first level)
- Concepts, questions , experimental approach and conclusions (slides)
- Other scientific papers contributing knowledge to the subject

What you will find on the **Moodle** website:

1. Textbook: *reviews* that you will use for studying the subjects
2. Lecture PDFs: the slides we used during the class
3. Research Papers: articles that we will analyze in detail
4. Bibliography: scientific literature concerning the subject
5. Exercises & tasks: utilities to help comprehension
6. Background help: materials for those of you who do not have sufficient basic knowledge

http://cmb.i-learn.unito.it/course/view.php?id=203

Textbook (see note next slide)

One ore more Reviews that Students should read and study carefully, since they contain most of the essential knowledge on the specific subject.

If anyone has difficulty in deciphering terms, there are good friends online: first, NCBI-EMBL; second, Wikipedia is OK for Molecular Biology, 99% guaranteed. Do not leave words floating empty in your mind !!!

Another excellent solution is to use Moodle Forum to post your questions and obtain help from other Students.

There is no specific textbook for this course, but

I suggest to have a reference textbook either in hardcopy or e-book to help you revise and understand basic knowledge and concepts.

Great book is: **Lewin's Genes XII**
(https://www.jblearning.com/catalog/productdetails/9781284104493)

If you are less strong in Genetics, or more interested in Medical Genetics, a real good alternative is:
Genetics and Genomics in Medicine by Tom Strachan
(https://www.crcpress.com/Genetics-and-Genomics-in-Medicine/Strachan-Goodship-Chinnery/p/book/9780815344803)

Basic book:

Genomes 4, by T.A. Brown (https://www.crcpress.com/Genomes-4/Brown/p/book/9780815345084)

Lecture PDFs

Slides used during class hours

are **NOT** a textbook !!!

Students should NOT limit their study to reiterated contemplation of teachers' PDFs !!

Research papers

These are original scientific articles that Students **should read and study very carefully**: they are paradigmatic in this field and teach us methodology, background and new conclusion

Analysis of results and methodology of these papers will be part of the final exam.

(Again, you may use Wikipedia and Students' Forum for help).

Bibliography

This is the collection of articles that your Profs have read to set up the lectures.

These articles are available if, for any reason, Students need or wish to access to the original information.

Tasks & exercises (called Activities)

These are Moodle activities intended to **help** comprehension of different subjects.

There will be also Technical Forums, Wiki based, where groups of Students will build up description pages on specific technical aspects.

Students' participation in Moodle activities will be <u>evaluated</u>.

Exercises and tasks on the Moodle site are part of your work !

Do it as soon as possible → acquire important knowledge → improved comprehension at next classes →

→ everything will be easier !!!

Background Help

This is a tutorial activity.

Students participating in this course have different backgrounds and also they have taken different courses during the first semester

We will assess the major background weakness and set up Tutorial help to recover missing information

Small green spots like the following may appear in the slides:

Mechanisms of DNA Replication

These refer to basic knowledge revision at **your charge**

Important.

Reading of the assigned Research Papers should **precede** discussion in the classroom

Papers will be made available one week before the cognate lecture

In the next part of Lesson 0 (Lesson 0.2)
you will follow a short presentation
on the scientific contents of this course